NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WARTIME REPORT

ORIGINALLY ISSUED

April 1943 as
Memorandum Report

VIBRATION SURVEYS OF THE P-40 RUDDER AND FIN-RUDDER ASSEMBLY

By Theodore Theodorsen and Arthur A. Regier

Langley Memorial Aeronautical Laboratory
Langley Field, Va.

NACA

WASHINGTON

MEMORANDUM REPORT

for the

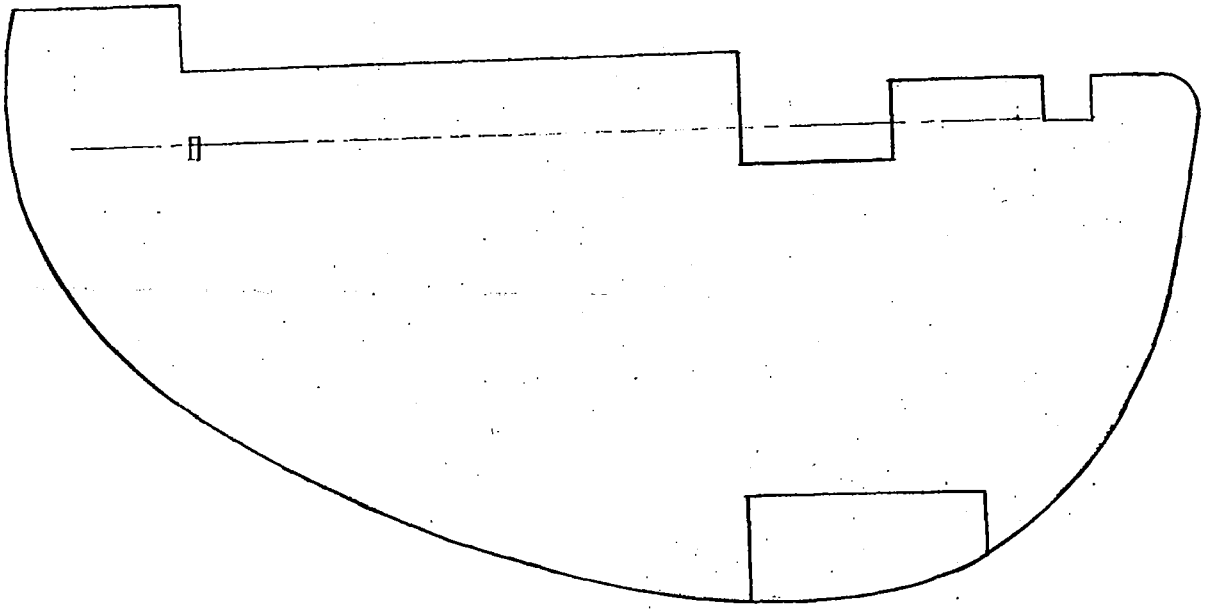
Army Air Forces, Materiel Command

VIBRATION SURVEYS OF THE P-40 RUDDER AND FIN-RUDDER ASSEMBLY

By Theodore Theodorsen and Arthur A. Regier

The following surveys on the vibration response of the P-40 rudder and fin-rudder assembly were conducted during the fall of 1942 for the purpose of obtaining information on the flutter characteristics of high-speed airplanes of known performance. This work is a continuation of similar study on the P-47 airplane. The tests on the rudder alone were made with the rudder suspended in a floating condition; the tests on the fin-rudder unit were made with the fin rigidly fastened to a concrete base. In the figures the plus and minus signs are used to signify opposite phases with the size of each sign proportional to the amplitude. In several figures the nodal lines are drawn.

Langley Memorial Aeronautical Laboratory,
National Advisory Committee for Aeronautics,
Langley Field, Va., April 28, 1943.



I. P-40-F FABRIC RUDDER

Part No. 87-14-60, 54-603

Weight..... 26 pounds
Maximum height..... 74 inches
Maximum chord..... 35 inches
Balance..... 47 inch pounds underbalance
Hinge line about 5 inches from leading edge
Radius of gyration, about
hinge line..... 10.5 inches approximately
Center of gravity..... 34 inches from top

Natural frequences (suspended in rudder with tab loose):

31.5, 47, 69, 85, 110, 125

Frequency, cycles per second	Remarks
31.5	Lowest bending..... 2 nodes.
47	Bending..... 2 nodes approximately perpendicular to nodes of lowest bending.
69	Torsion..... 1 node along hinge line and 2 nodes perpendicular to hinge line.
85	Bending..... 4 nodes.
110	Local bending and torsion.
125	Local vibration.

II. FIN AND RUDDER ASSEMBLY FOR CURTISS P-40-F AIRPLANE

	Metal fin data	Fabric rudder data
Part No.	87-12-50, MF 1208	87-14-60, 54-603
Weight	13.5 pounds	26 pounds
Maximum height	46 inches	74 inches
Maximum chord	37 inches	35 inches
Maximum thickness	4.6 inches	

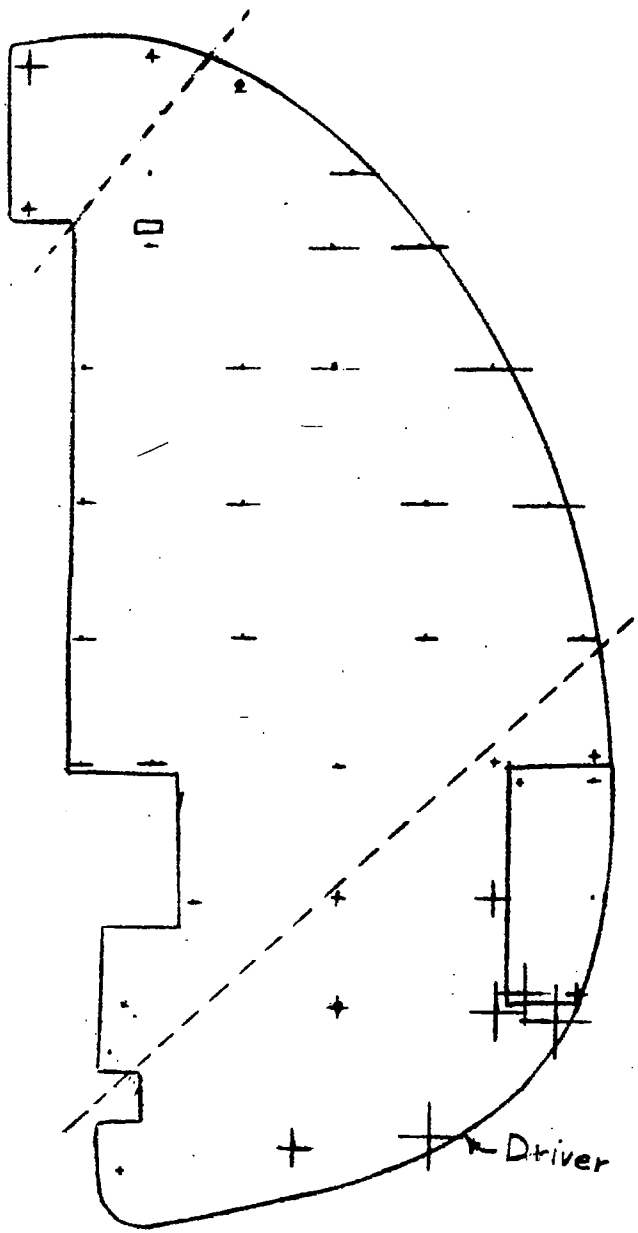
Vibration frequencies as mounted on concrete:

Fin alone.....bending 85 cycles per second

Frequencies of assembly as mounted on concrete:

21.5, 37.5, 56, 62, 82, 91, 101, 107, 125

Frequency, cycles per second	Remarks
85	First bending of fin alone.
21.5	First bending of combination. No nodes except at support.
37.5	Bending with one node in rudder and node at top counterweight.
56	Torsion with one node near hinge line and two nodes perpendicular to hinge line.
62	Same as above except that fin has reversed phase with respect to the rudder.
82	Bending with three nodes.
91	First bending of fin with three nodes in rudder.
101	Fin bending with local rudder responses.
107	Local vibration.
125	Local vibration.



P-40-F Rudder
No. 87-14-601
Suspended in Rubber
Tab Loose

Oct. 3, 1942

31.5 ~/sec

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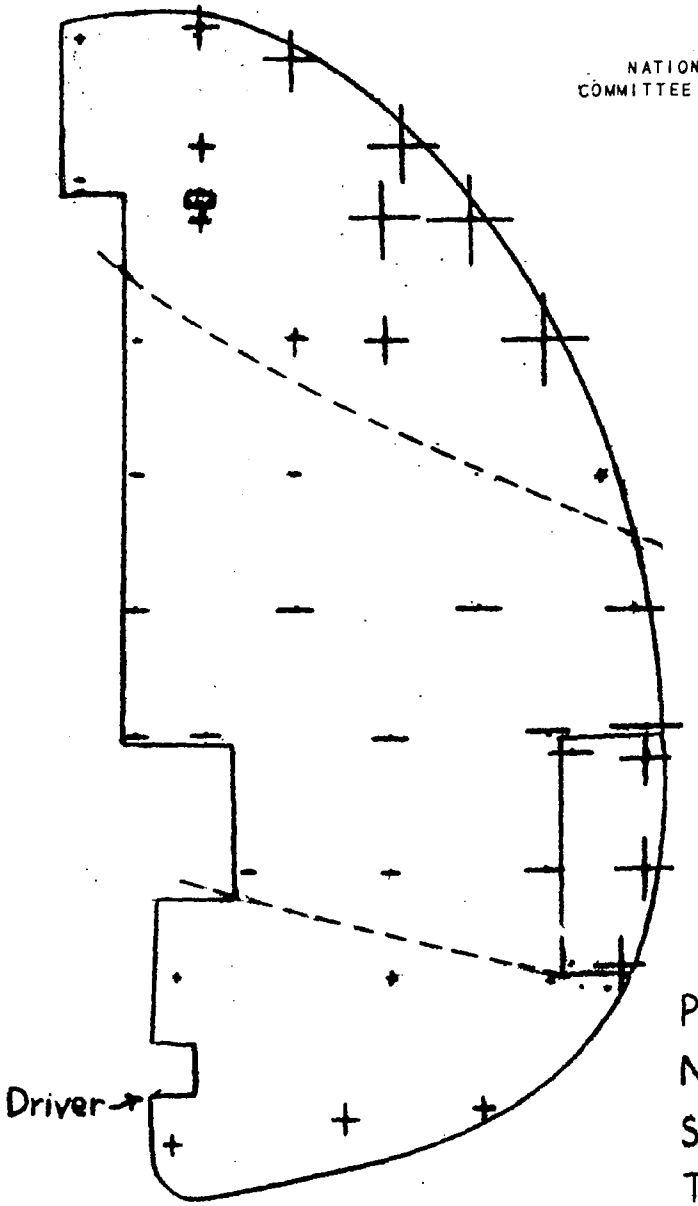

P-40-F Rudder
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Suspended in Rubber
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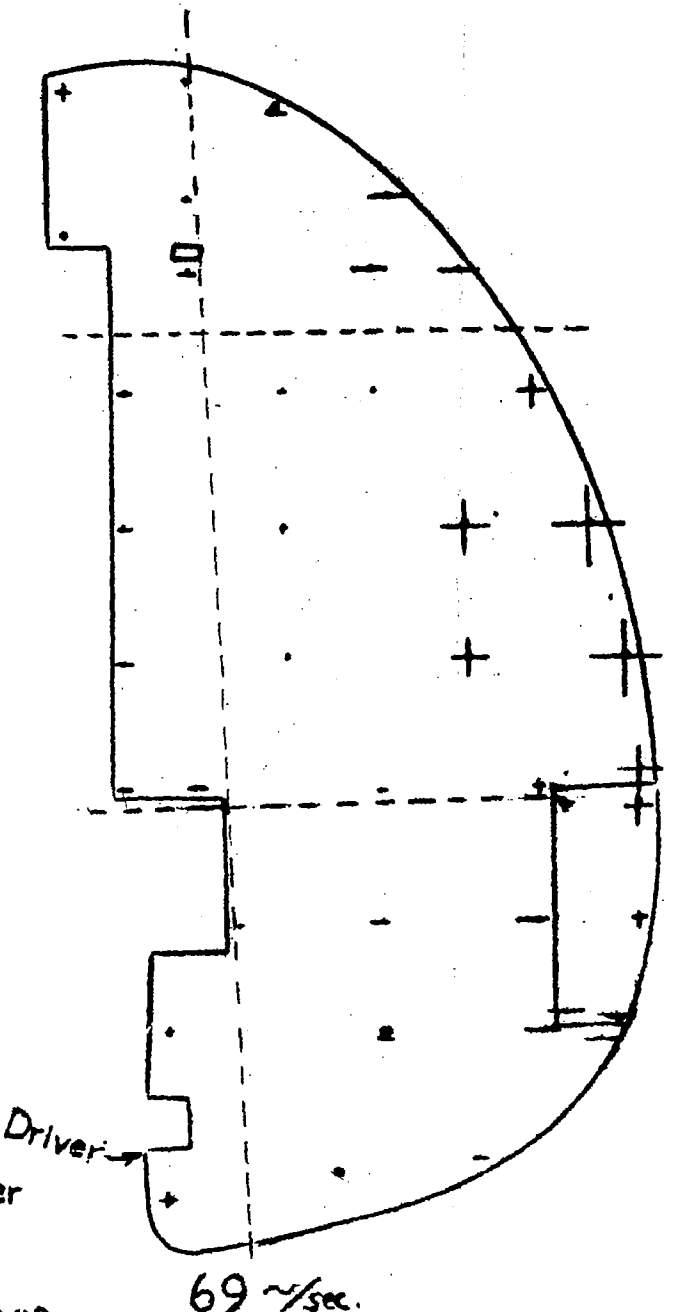
Oct. 3, 1942



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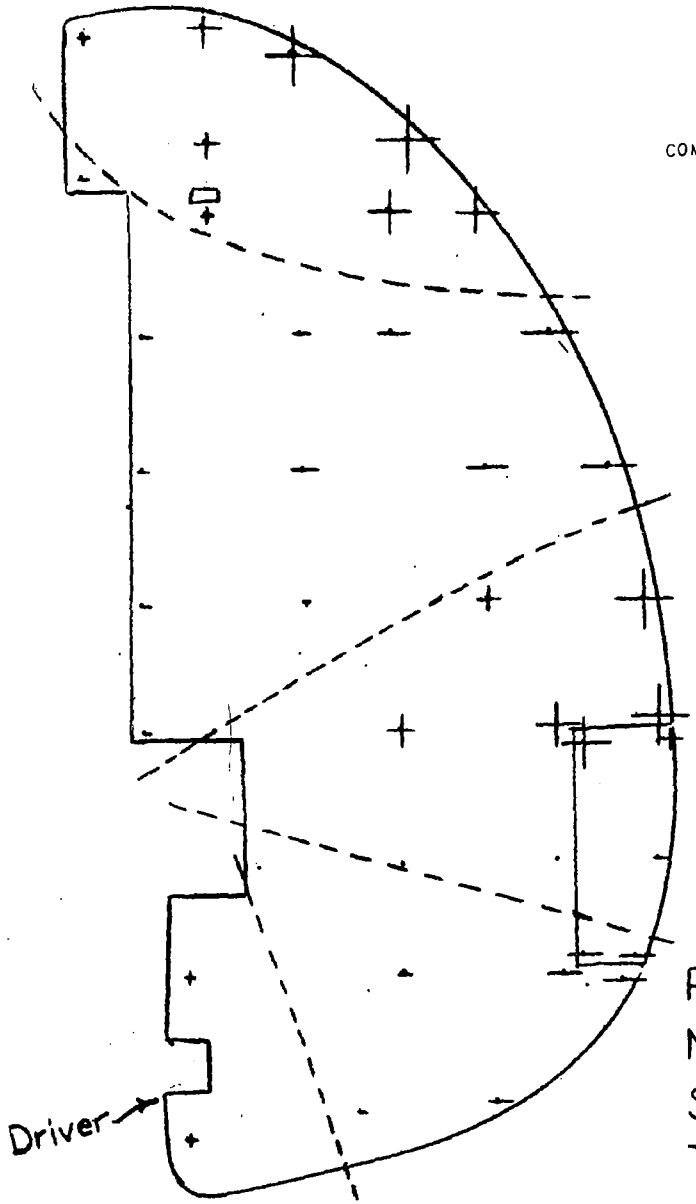

85 ~/sec.

P-40-F Rudder
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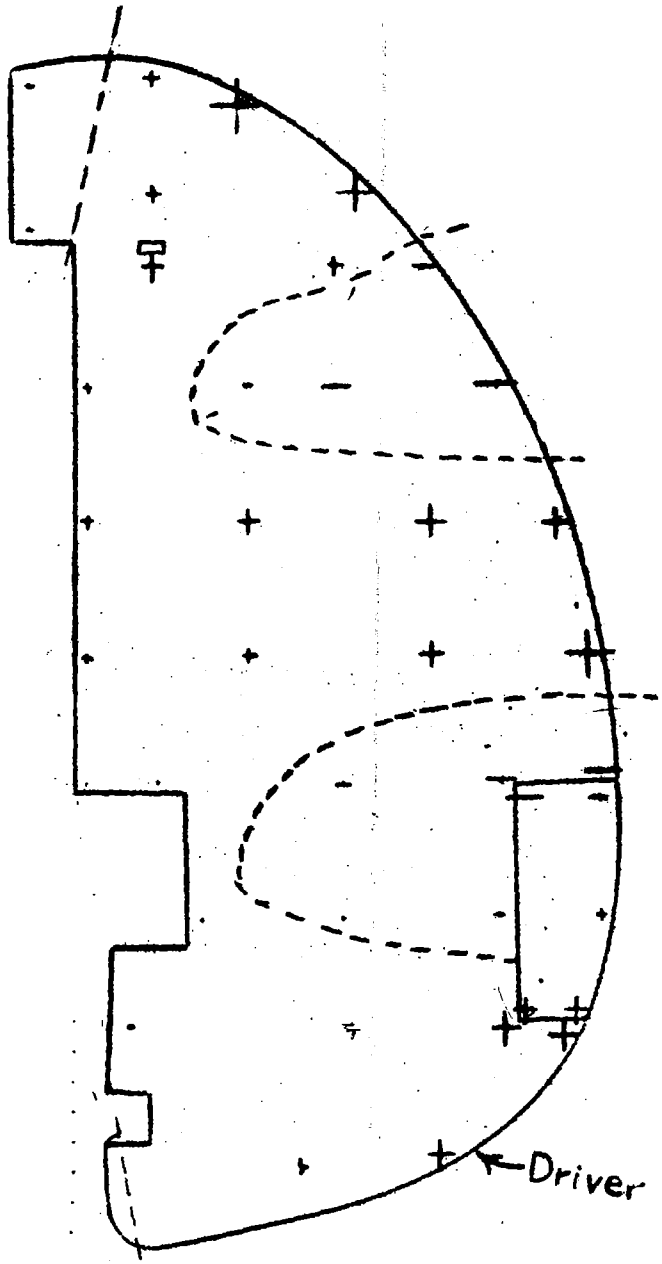
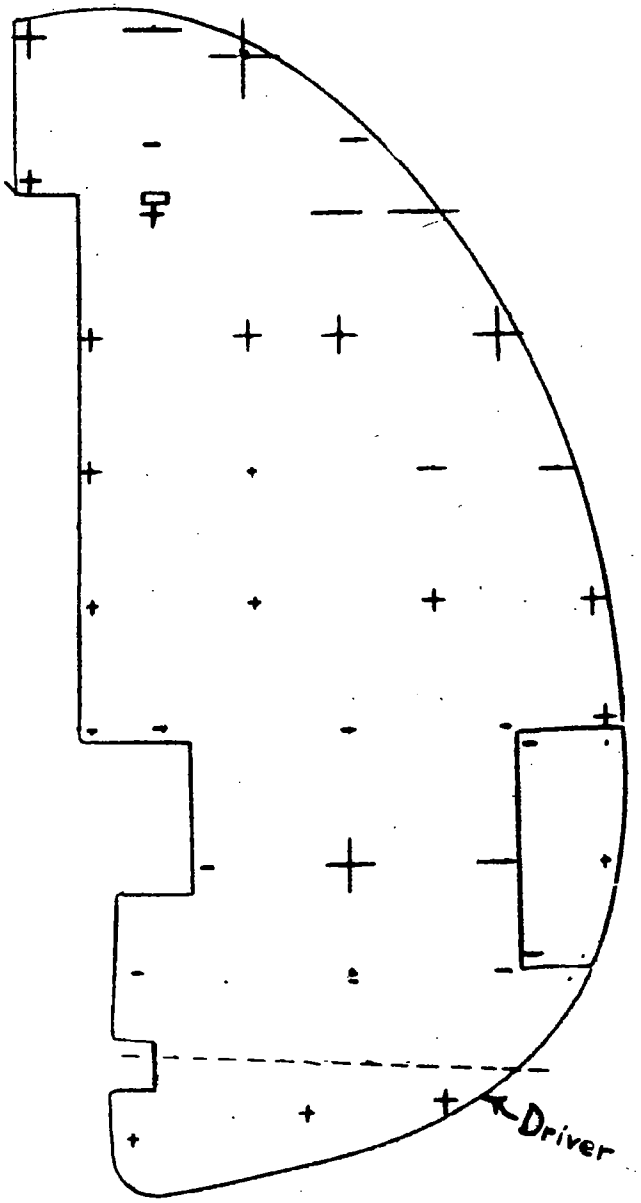


110 ~/sec.



P-40-F Rudder
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125 ~/sec.

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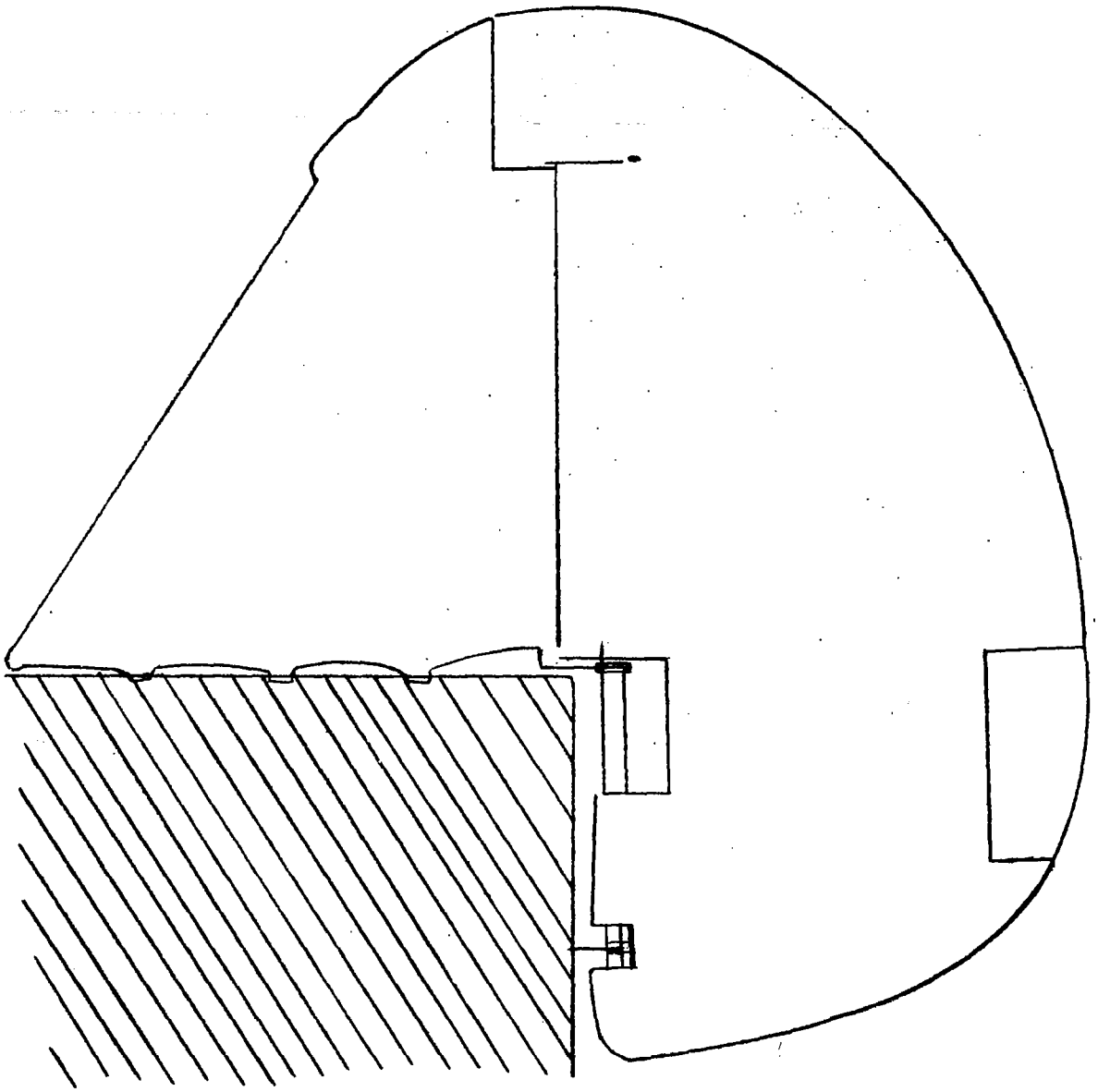

Fin and rudder assembly for Curtiss P-40-F airplane.

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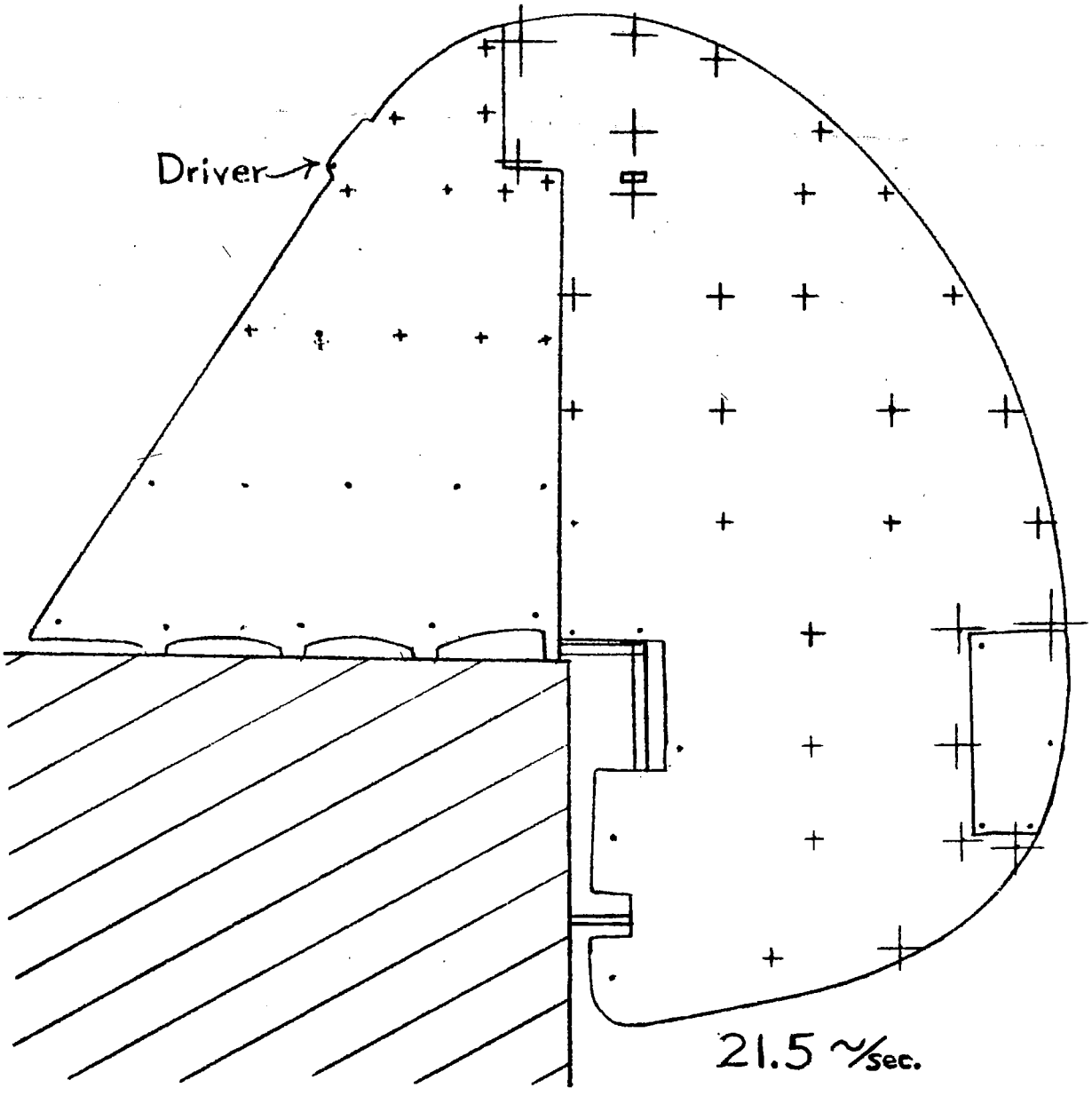
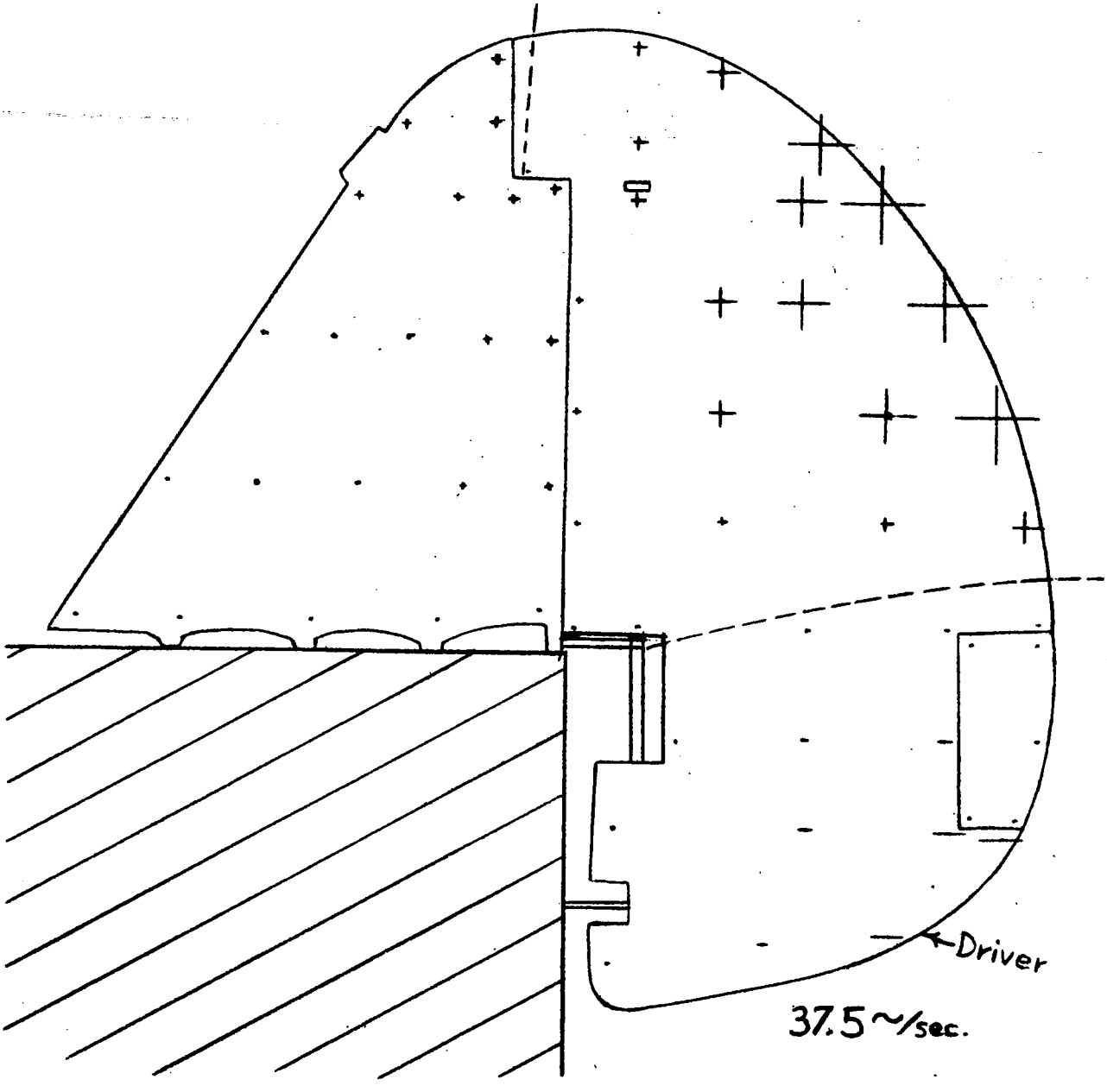


P-40. Rudder Attached to Fin
on Concrete Block, Tab Loose
Oct. 6, 1942



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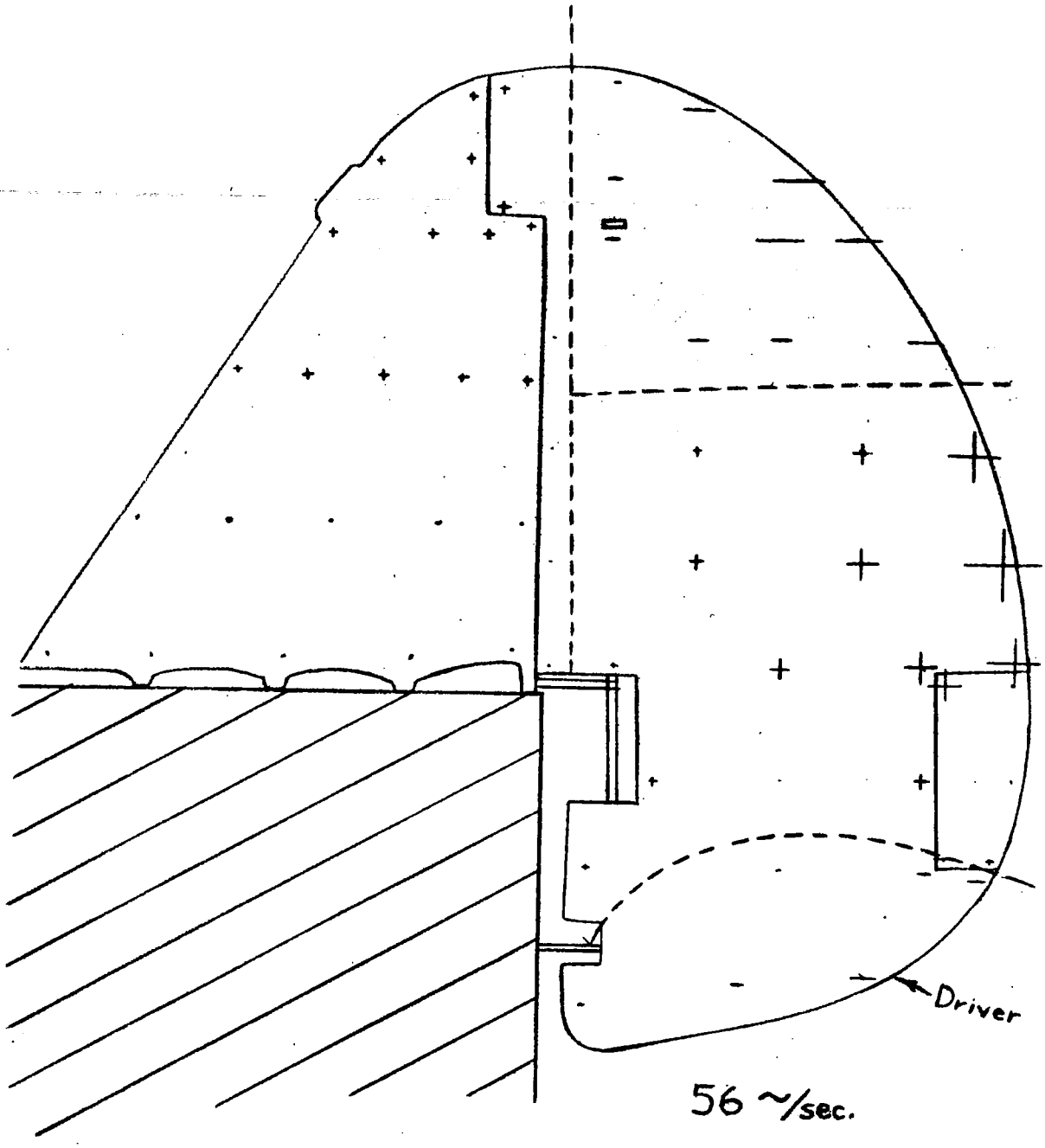
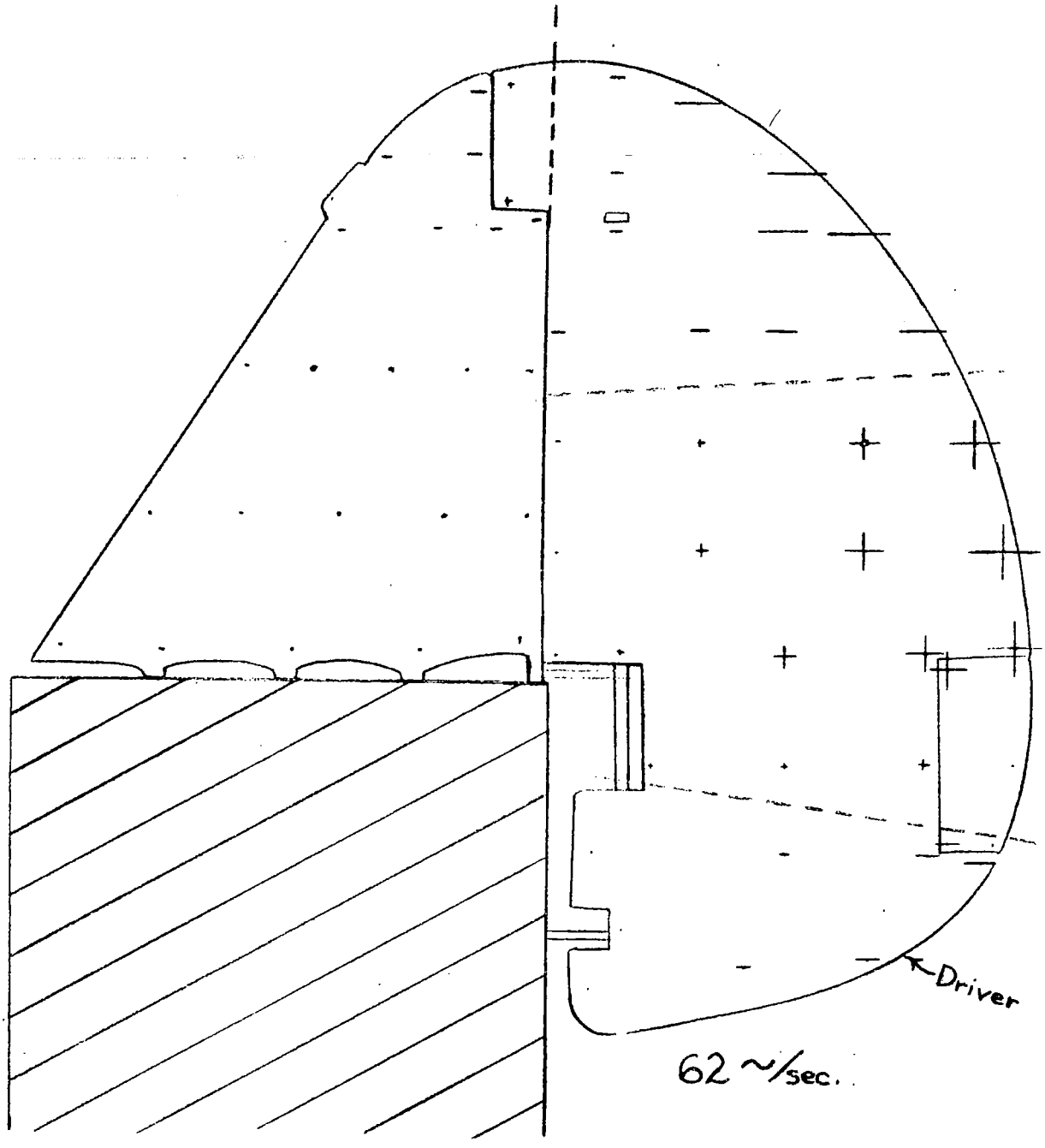


56 ~/sec.

P-40 Rudder Attached to Fin on Concrete Block, Tab Loose

Oct. 5, 1942



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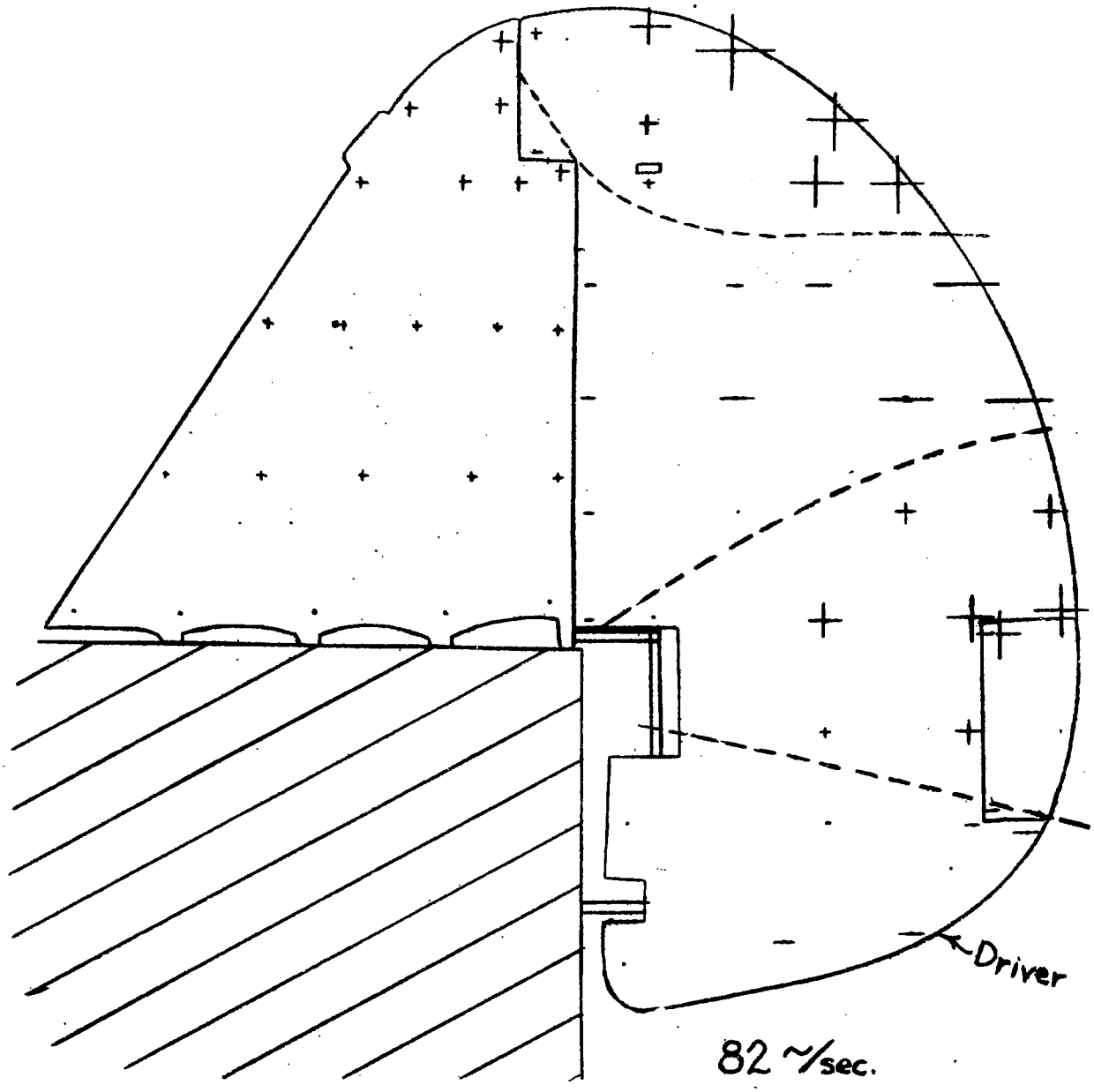

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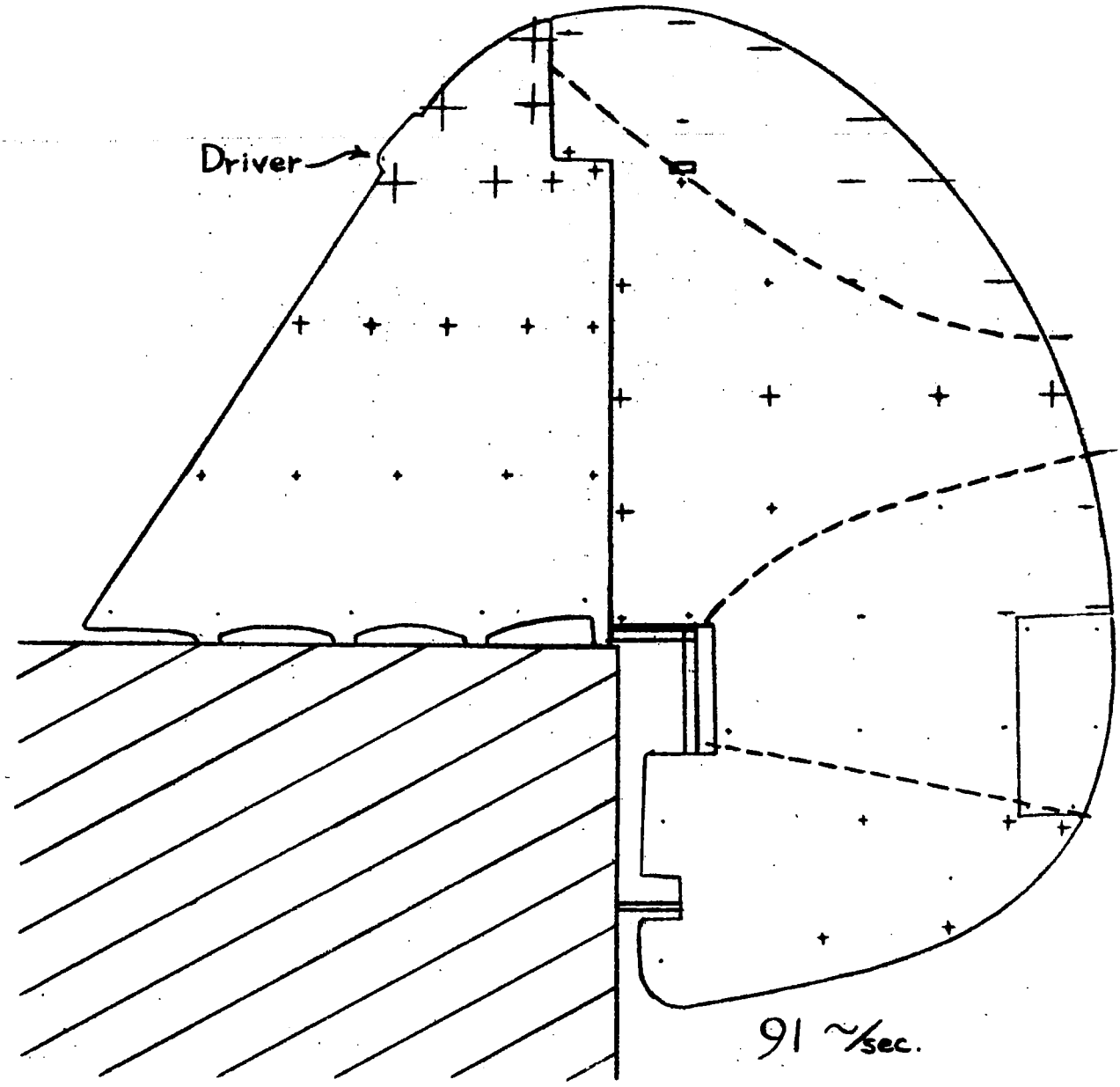

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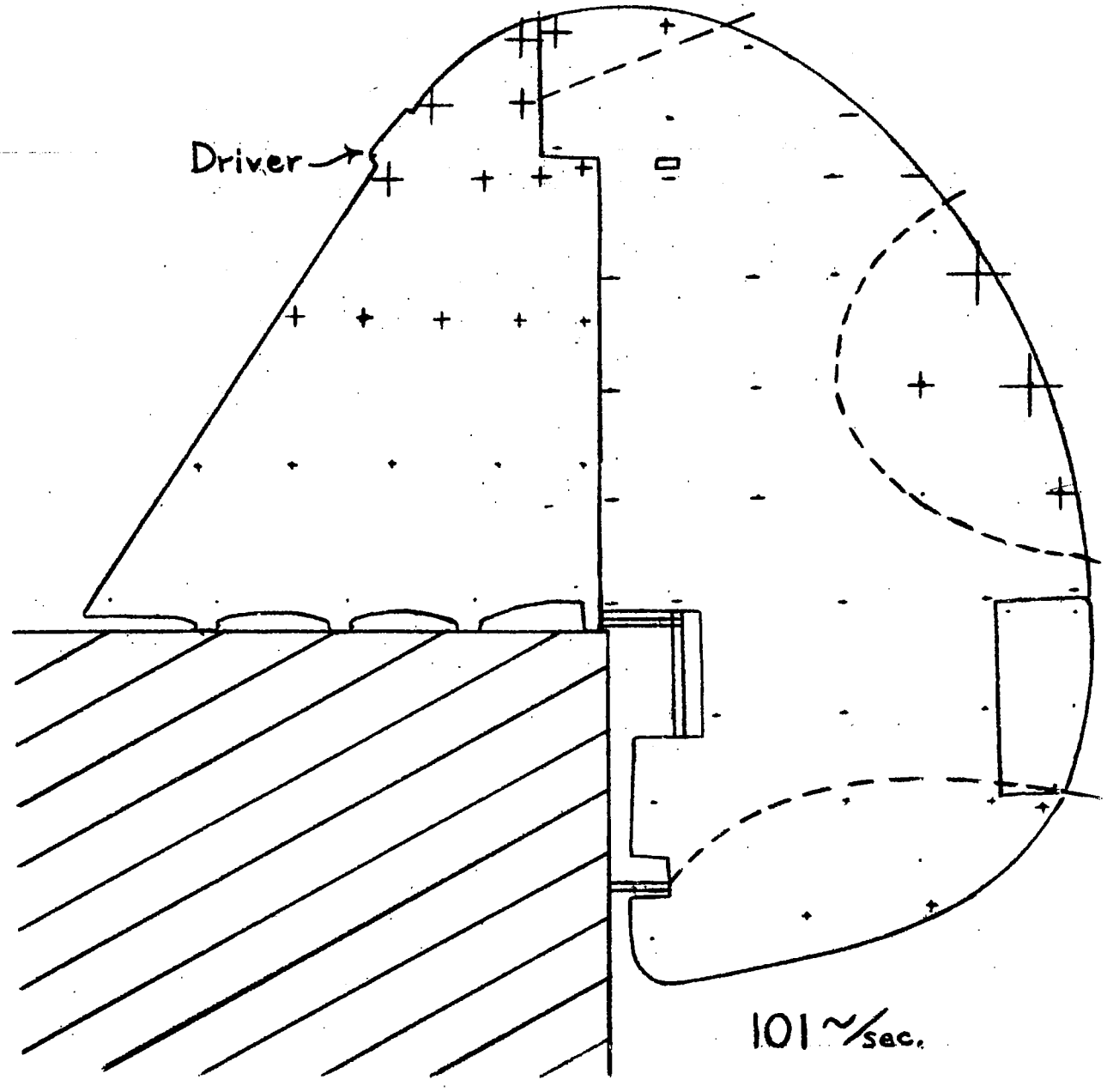

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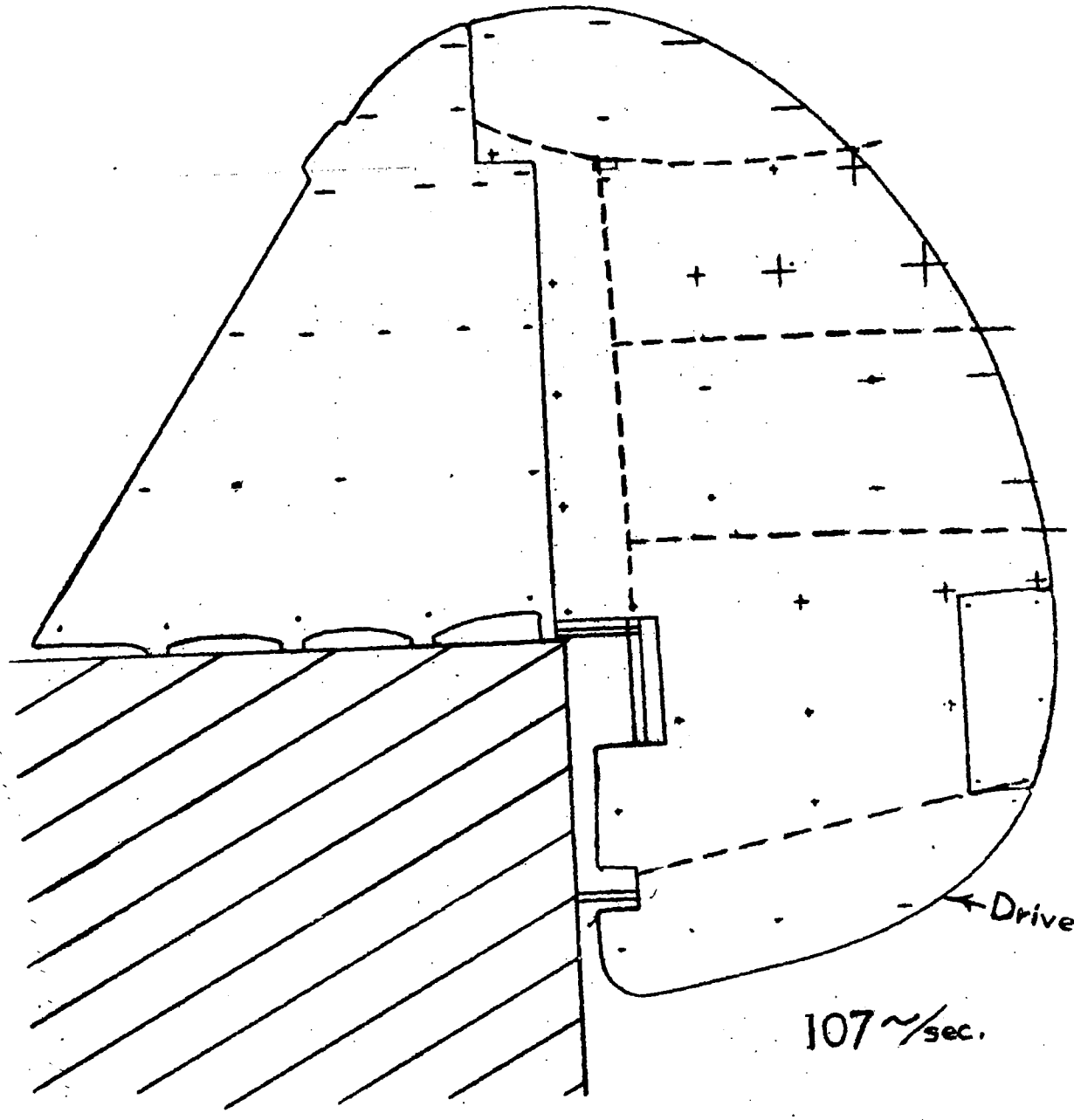

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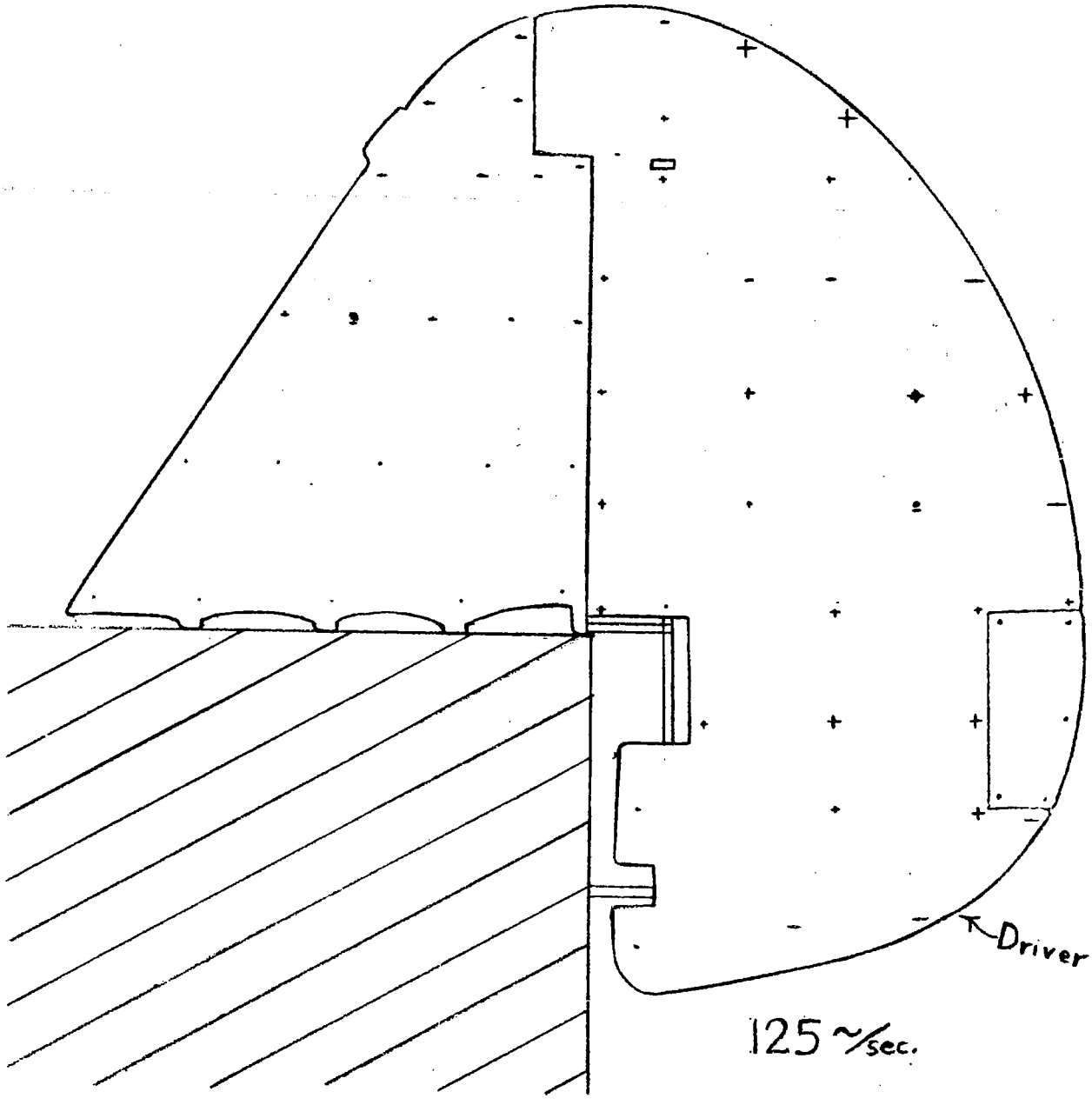

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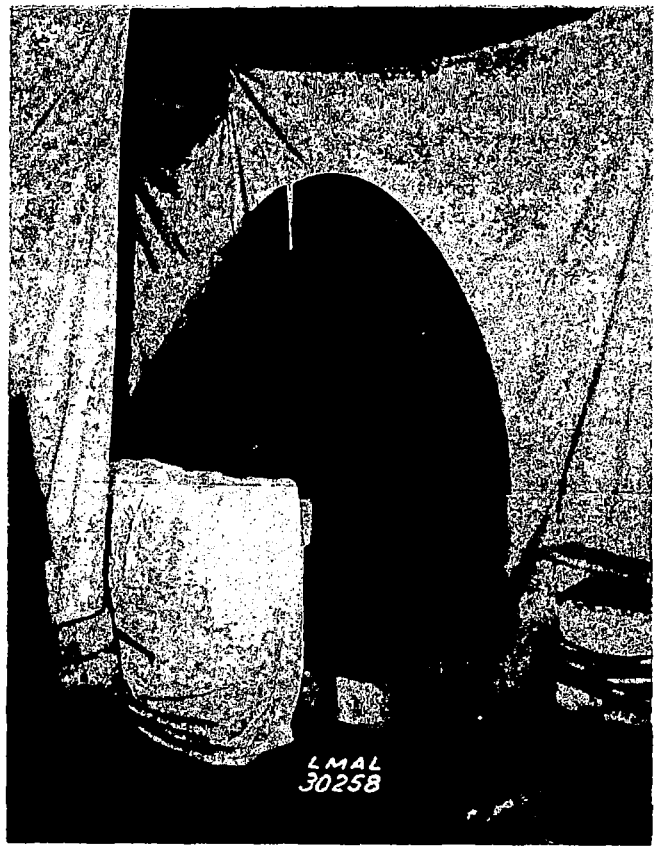

P-40 rudder and fin-rudder assembly.